EXPANDABLE LENS REPLACEMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to surgically inserted intraocular lenses, and more particularly to the apparatus and method for inserting liquid filled lenses into the natural capular bag of an eye.

2. Description of the Prior Art

Surgical implantation of synthetic intraocular lenses is a known practice in the treatment of optical diseases and is a method of preference in the treatment of cataract. Most typically the implanted lens is of a hard material (acrylic or silicon polymer) inserted in the ciliary sulcus or within the natural lens capsule of the eye after removal of the anterior capsule and the lens substance. While acceptable in many instances, a hard lens implant occasionally causes irritation.

While widely practiced, both the hard lens and the soft lens implants are large and thus entail extensive surgical incision with consequent extensive trauma. More importantly, lens shape, and position must be selected at the time of surgery and the lens must be securely fixed against movement. All these factors prompted alternative procedures, particularly procedures which permit post operative lens modification with minimal trauma.

One such procedure is described in U.S. Pat. No. 4,373,218 to Schachar. This procedure entails the insertion of an expandable sack into the cavity previously occupied by the lens capsule of the eye. A tube or neck projecting from the sack is then available for adding or withdrawing fluid which thus controls the inserted shape of the sack.

While suitable for the purposes intended this last procedure entails extraction of the natural lens capsule, an event coupled with unavoidable trauma, and the movement of vitreous liquid anterialy. Accordingly, less traumatic corrections of a diseased eye are extensively sought and it is one such technique that is disclosed herein.

SUMMARY OF THE INVENTION

It is, therefore, the general purpose and object of the present invention to produce a lens replacement technique which substantially retains the natural lens capsule and eliminates the need for a large surgical incision

Other objects of the invention are to provide a technique for lens replacement with minimal trauma.

These and other purposes and objects are uniquely resolved by the instant technique which is best described by reference to the natural processes occurring in the eye. In the human eye the posterior and anterior lens capsules contain lens substance which occasionally is diseased, as in cataract, and thus is evacuated to restore full vision. When the lens substance is evacuated the intraocular fluid pressure collapses the anterior and posterior lens capsules into proximity which then causes natural regrowth of the lens substance. This regrowth commences dominantly in the capsular periphery and occassionally in other capsular locations. See "Lens Refilling and Regrowth of Lens Substance in the Rabbit Eye" by Julius Kessler M.D., Annals of Opthalmology, August, 1975 at pp 1059–1062. This regrowth of lens substance, furthermore, includes fibrous content which, while inconsequential to hard lens implants, produces some distortion with time to soft lens implants or the implants of fluid filled lenses. This regrowth effect is particularly pronounced in young patients.

Accordingly, the recent prior art suggests hard lens replacements which are some times anchored in place by peripheral ribs or radial extension as in U.S. Pat. Nos. 4,589,147 to Nevyas, 4,591,358 and 4,477,931 to Kelman and 4,073,014 to Paler. In each instance large and therefore traumatic incisions are necessary in the insertion procedure of the intraocular lens. Less invasive techniques, exemplified by the teachings of U.S. Pat. No. 4,542,542 to Wright, suggest the removal of the lens substance in the capsular bag and replacement by polymeric compositions which then cure in place. This procedure results in a lens implant of a shape defined by the capsular bag of the eye and the pressure at which the compositions are introduced.

To provide a minimally invasive lens replacement technique which is of a more predictable shape and which also allows for adjustment of the lens shape I have devised a method in which a captic or peripheral spreader is inserted into the evacuated capsular bag and within which an expandable sack is received. The expandable sack is then filled with clear fluid to pressure providing the lens shape by controlled expansion of shaped sack surfaces.

In one preferred form the sack and the peripheral spreader are parts of an expandable structure, the peripheral spreader forming a concentric, toroidal, cavity around the central sack. Both these expandable structures are formed of a resilient, collapsible, film which is rolled or folded and inserted into the evacuated capsular bag. Thereafter the peripheral spreader and sack volumes are separately expanded, the first to separate the anterior, equatorial and posterior capsules an the second to define the necessary optical shape.

Alternatively, the peripheral spreaders may be formed as arcuate segments insertable seriatium through a small opening into the capsular bag, the same opening being utilized for the insertion of the collapsed sack to minimize trauma.

In both implementations the sack material may be formed in distributed varying thickness which then controls the resulting lens shape by internal pressure. Moreover, expandable sacks may include ports, valves and/or filler extensions through which the internal fluid is injected.

In both forms the sack is implanted without the usual removal of the natural capsule bag the peripheral spreader then separating the anterior and posterior capsules to limit the problematic regrowth of lens substance. The procedure thus summarized minimized the operative trauma while controlling growth and at the same time permitting post surgical adjustments to the lens.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a human eye useful in setting out the invention herein;

FIG. 2 is a sectional detail of the eye shown in FIG. 1 illustrating the initial step of the inventive procedure set out herein;

FIG. 3 is yet another sectional detail of the eye illustrating a further step of the inventive procedure;

FIG. 4 is a perspective illustration of the eye, in partial section, illustrating a first example of an implantable lens in accordance with the present invention;